

mental and mathematical work. They belong to the domain of mathematical physics. It is scarcely creditable to the laboratories and graduate students of American universities that many of them do not devote themselves to the study of problems in physics that have such important applications to meteorology. We believe that both the Astrophysical Observatory of the Smithsonian Institution and the Solar Physics Observatory of the Carnegie Institution, on Mount Wilson, will do much to elucidate our problems, but the field is broad enough for many other coworkers, some of whom must seek for stations in the thinnest, driest, clearest air that is attainable anywhere on the globe—C. A.

SONORA STORMS AND SONORA CLOUDS OF CALIFORNIA.

By ARCHIBALD CAMPBELL. Dated Campo, Cal., September 17, 1906.

As to the "sonoras," or sonora clouds, as they are generally called on the Pacific coast (see fig. 1), I can only explain them thus: They were, I believe, so named by the old Spanish or Indian settlers of the high Sierras of Lower California, who from their elevated positions, 5000 to 7000 feet above sea level, looking across the narrow Gulf of California, could see these masses of clouds form, seemingly in the state of Sonora, Mexico, and rising as if from the plains of Sonora, in a few hours drench them with floods of rain.



FIG. 1.—Sonora cloud.

The belt on which these storms fall is from twenty to forty miles in width, east to west, and the length from north to south in Lower California is 450 miles, and in the United States 120 miles, mostly in San Diego County, but a small part in Riverside County, California, extending over the Laguna, Cuyamaca, and Palomar mountain ranges, southeast to northwest, ending at the north end of the Palomar Mountains, in Riverside County, and in the high backbone of the mountain range between the Imperial Desert and the coast. The conditions go no farther west than the 2000-foot elevation of this latter mountain chain, the backbone and source of all our San Diego County rivers. If we in southern California had the naming of the Sonoras, looking at them from our more northerly mountain tops, we might have called them the Arizonas, as to us they seemingly rise there. Very seldom does this cloud formation extend into the low belt of the coast, nor to the east into the desert, but occasionally, to the surprise of the inhabitants there, it does take a daring sweep out of its usual confines and give them a waking up from their sleep with lightning, thunder, and rain. The oval area covered by the sonoras is about the wettest spot on the Pacific

coast, with sometimes an annual rainfall of fifty to sixty inches at Cuyamaca and Laguna. Here at Campo the United States Signal Officer caught and measured one of the downfalls, recording 16.10 inches of rainfall in August, 1890, in a few hours of one day. Some call these rains the tail end of the tropical showers. The first indications we have of the periodical coming of these storms in early July are low, white, flat banks of clouds in the southeast, which in a day or two form into castellated clouds and break into thunder, lightning, and rain. Often till near noon the sky is clear of clouds, then perhaps in an hour or so the sky is clouded all over with tremendous masses of solid-caverned thunderheads, which break in a short time into tremendous volumes of rain and

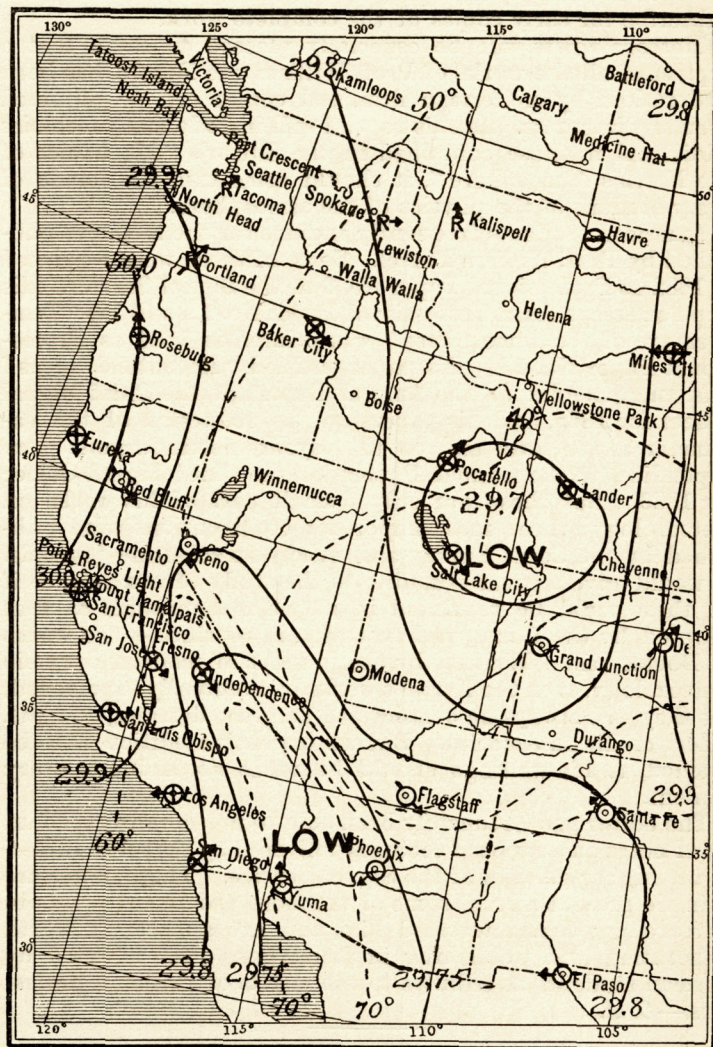


FIG. 2.—Weather map showing conditions which usually prevail during Sonora cloud period.

often destructive hailstorms. Sometimes for weeks at a time the whole belt, over 500 miles long, experiences unceasing thunder and lightning, and rain in partial areas. Sometimes these storms make a complete circuit of the horizon, commencing in the east and southeast with massive clouds, snow-white to dark gray, with tremendous up-sweeping clouds; then comes a rapid cannonade of thunder, with the most brilliant lightning ever seen; then the clouds rapidly move from their first base to south, southwest, and west, and so on in rapid succession till they make a complete circuit; but now and again they break off like a meteor into space and take a rapid straight course to the west or northwest toward the coast, so that for fifty to sixty miles one can follow them by the ever

decreasing thunder and the display of distant lightning. But in the center of this commotion we often get terrific thunder, lightning, and rain, shaking our houses like an earthquake. Last week three head of cattle were killed here by lightning, and on the very high mountain valleys amongst the tall timber many pine trees are ruined every year by lightning. The season of these storms lasts from July to early in October. The weather conditions during the three months of their duration are about as on the accompanying weather map (fig. 2) in the southwest corner "low." At its commencement the weather forecaster usually says of this low: "The usual summer conditions prevail in the southwest," or words to that effect. The only reports to the Weather Bureau of rainfall from this section are from Campo, Cuyamaca, and Nellie. For a number of years I reported for Laguna, but the frosts burst three rain gages for me. During the building of Moreno dam, reports were received from that place.

THE SANTA ANNA OR DESERT WINDS.

While I was writing the preceding lines another of our California climatic visitants with a Mexican name commenced on the 16th instant, the "Santa Anna", so called from the town of Santa Anna, near Los Angeles, where they blow with great violence and with volumes of dust so as to obscure the sky while they last. They are northers or "norther winds" there, and also in the big San Joaquin Valley of upper California. I was once lost there for three days, in one of them, and probably was not more than three miles from home all the time. In San Diego County we call them desert, or east winds; they come to us straight from the east, while in the desert they are west winds. They blow during periods of three to six or nine days, but rarely last beyond twenty-one days. They are cool winds to us here on the mountains, while on the coast they are hot, and are skin-drying, lip-cracking, unpleasant visitants. After they reach the coast the force is mostly out of them. Sometimes their force at Campo rivals a hurricane. In places they pierce window panes with little round holes as if drilled by the coarse gravel they carry like a dose of small shot. On my ranch on the Laguna Mountains, at an elevation of 6500 feet, all the east side is in big pine and oak timber for some miles; yet on the last ridge, overlooking the desert on the east, not a tree grows for miles, altho north and south they grow up to within 200 yards of it all along. Even the brush changes on that last ridge from a growth of six to ten feet down to all dwarf, creeping and clinging close to the ground, but of the same varieties as the upright. These winds are so violent that they often tear down houses. Their duration is from October to March. We generally get our first fall rains after the blow is over, but this year the first rain, on the 15th, preceded this one. If they come in the spring after the fruit blooms or forms, both the bloom and the young fruit drop off the trees after a short time. The barometer responds more quickly to an east wind than to any other change of weather.

HAS THE GULF STREAM ANY INFLUENCE ON THE WEATHER OF NEW YORK CITY?¹

SIR: Your letter of September 14, requesting information as to supposed variations in the course of the Gulf Stream, and the possibility of the variations acting as a controlling factor in the climate of the city of New York, has been received.

The Bureau is in almost daily receipt of inquiries of this and a similar nature, all having their origin in a misconception of the character and extent of that motion of the ocean

¹ The above letter, by Mr. James Page, was sent in reply to a gentleman who had been told that a mild winter in New York city was due to the fact that the Gulf Stream is running 60 miles nearer shore than previously. We hope that its publication may contribute to correct the numerous popular misapprehensions relative to the important part played by the Gulf Stream in the economy of nature.—EDITOR.

waters to which the name Gulf Stream may properly be applied. Speaking with precision, the term should be limited to that continuous discharge of the water of the Caribbean Sea and the Gulf of Mexico which takes place thru the Straits of Florida, a narrow outlet bounded on its western side by the State of the same name, and on its eastern by Cuba and the Bahama Islands and Bank. Thru this channel, constricted in its narrowest portion to a width of 32 miles, there is a constant outflow of the warm, equatorial waters heaped up in this vast and almost landlocked basin by the persistent action of the trade winds, rising at times in mid-stream to a velocity of four or five knots, and having a constant temperature of 81° or 82° F. The impetus imparted to this water by the pressure from the rear is moreover sufficient to maintain it in motion for a considerable distance beyond the actual point of exit from the channel proper, which may be considered as terminating at Matanilla Shoal, the northern extremity of the Great Bahama Bank, in latitude 27° north. As a result the stream continues to be felt as a distinct body of warm water about forty or fifty miles in width, moving steadily onward, but with uniformly diminishing velocity and temperature, until a point opposite Cape Hatteras is attained, or even opposite the Capes of the Chesapeake. Beyond this point, however, the warm current spreads out over the adjacent area of the ocean like a vast fan, and the identity of the stream is consequently obliterated in the general eastward drift which characterizes the waters of the temperate latitudes.

Speaking then with precision, the Gulf Stream is a current of warm water, forty or fifty miles in width, which emerges from the Straits of Florida, follows the coast of the United States northward as far as the Capes of the Chesapeake, and is there merged in the generally eastward drift underlying the prevailing westerly winds of the temperate latitudes. To describe it in the language of Maury as "a river in the ocean, having its fountain in the Gulf of Mexico, and its mouth in the Arctic Seas" is picturesque, but highly exaggerated and erroneous.

With reference to movements of the stream (viz changes in its location as a whole), reports of which, furnished by navigators, appear from time to time in the daily newspapers, it may be said that these probably do exist, altho within narrow limits. Observations of the "set" experienced by vessels crossing the stream, as also of the warmth of the surface waters, show that the position of the axis, or line of greatest velocity, as also that of the line of maximum temperature, may vary from day to day over a range of fifty miles. The methods of observations employed are, however, so replete with sources of error that little confidence can be placed in any single result. That such movements can have any effect upon the climate in the vicinity of New York is highly improbable, the stream itself in these latitudes being so dispersed as to be almost indefinable, and the modifications of the surface temperatures of the adjacent waters wrought by a temporary change in its position being certainly negligible.—J. P.

ON THE FORMATION OF ANCHOR ICE, OR GROUND ICE, AT THE BOTTOM OF RUNNING WATER.

By H. T. BARNES, D. Sc., Associate Professor of Physics, McGill University, Montreal.
Dated December 4, 1906.

A recent paper¹ on ground ice, by M. J. de Schokalsky, calls attention to the formation of ice at the bottom of Lake Ladoga, near St. Petersburg, and a general description of the ice was given. No suggestions were made, however, as to the cause of the phenomenon, and it was stated that beyond the important report of M. F. Wladimirop², little attention had been directed to the study of it. For the past ten years the writer has been observing, from time to time, the same

¹ Comptes Rendus, vol 143, p. 261 (1906). Science Abstracts, vol. 9, p. 455 (1906).

² Water Works Commission, St. Petersburg (1904).